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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte JOHN F. ACKERMAN,
VENKAT S. VENKATARAMANI,
IRENE T. SPITSBERG,
BRETT ALLEN R. BOUTWELL, and
RAMGOPAL DAROLIA

Appeal 2008-3558
Application 10/735,370
Technology Center 1700

Decided: September 29, 2008

Before EDWARD C. KIMLIN, CHUNG K. PAK, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

KIMLIN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal from the final rejection of claims 1-7, 9-11, and 13-31. Claims 1 and 13 are illustrative:

1. A method for preparing a protected article, comprising the steps of providing the article;

depositing a bond coat onto an exposed surface of the article; and

producing a thermal barrier coating on an exposed surface of the bond coat, wherein the step of producing the thermal barrier coating includes the steps of

depositing a primary ceramic coating onto the exposed surface of the bond coat, wherein a surface of the primary ceramic coating comprises columnar grains having facing surfaces,

depositing a cerium-oxide-precursor compound onto the facing surfaces of the columnar grains of the primary ceramic coating, wherein the cerium-oxide-precursor compound is not cerium oxide with cerium in a +4 oxidation state, and

heating the cerium-oxide-precursor compound in an oxygen-containing atmosphere to form cerium oxide with cerium in the +4 oxidation state adjacent to the facing surfaces of the primary ceramic coating and leaving air-filled gaps between the facing surfaces of the columnar grains.

13. A method for preparing a protected article, comprising the steps of providing the article;

depositing a bond coat onto an exposed surface of the article; and

producing a thermal barrier coating on an exposed surface of the bond coat, wherein the thermal barrier coating comprises

a primary ceramic coating on the exposed surface of the bond coat, wherein a surface of the primary ceramic coating comprises columnar grains with facing surfaces, and wherein the primary ceramic coating has an excess of oxygen vacancies therein, and

a sintering-inhibitor region at a surface of the primary ceramic coating, wherein the sintering-inhibitor region comprises cerium oxide with cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating and in a concentration greater than a general cerium oxide concentration in the primary ceramic coating, and wherein there are air-filled gaps between the facing surfaces of the columnar grains.

The Examiner relies upon the following references as evidence of obviousness:

Vine	4,861,618	Aug. 29, 1989
Taylor	5,520,516	May 28, 1996
Ueda	5,697,992	Dec. 16, 1997
Stoffer	5,932,083	Aug. 3, 1999
Villiger	US 2001/0003631 A1	Jun. 14, 2001
Subramanian ('945)	6,296,945 B1	Oct. 2, 2001
Subramanian ('082)	6,756,082 B1	Jun. 29, 2004

Wei Liu et al, "Total Oxidation of Carbon Monoxide and Methane over Transition Metal-Fluorite Oxide Composite Catalysts," *Journal of Catalysis* 153, 304-316 (1995).

Appellants' claimed invention is directed to a method for preparing a protected article, e.g., a component of a gas turbine engine. The method entails depositing a primary ceramic coating comprising columnar grains having facing surfaces onto the article, such as an yttria-stabilized zirconia primary ceramic coating. A cerium-oxide-precursor compound or cerium oxide is deposited on the facing surfaces of the columnar grains of the ceramic coating. The cerium oxide removes oxygen vacancies to provide a sintering-inhibitor region at the surface of the ceramic coating.

Appealed claims 13-21 stand rejected under 35 U.S.C. § 112, first paragraph, written description requirement. Also, the appealed claims stand rejected under 35 U.S.C. § 103(a) as follows:

(a) claims 13-17 and 19-21 over Subramanian '945 in view of Stoffer,

(b) claims 1-5, 7, 9 and 13-21 over Villiger in view of Subramanian '082, and Liu,

(c) claims 6 and 11 over the combination of references states in (b) above further in view of Ueda,

(d) claim 10 over the combination of the references stated in (b) above further in view of Taylor,

(e) claims 1-5, 7, 9, 10, and 13-21 over Villiger in view of Taylor and Liu,

(f) claims 6 and 11 over Villiger in view of Taylor, Liu, and Ueda and,

(g) claims 19-21 over Villiger in view of Vine and Liu.

We have thoroughly reviewed each of Appellants' arguments for patentability. However, we are convinced that the Examiner's rejections are free of reversible error. Indeed, we are in complete agreement with the Examiner's reasoned analysis and application of the prior art, as well as the cogent disposition of the arguments raised by Appellants. Accordingly, we will adopt the Examiner's reasoning as our own in sustaining the rejections of record and we add the following for emphasis only.

We consider first the Examiner's rejection of claims 13-21 under § 112, first paragraph, written description requirement. At the outset, we note that Appellants advance an argument only against the rejection of claim 13. Accordingly, we will, perforce, sustain the Examiner's § 112, first paragraph, rejection of independent claim 19 and claims dependent thereon.

We agree with the Examiner that the claim 13 recitation "wherein the primary ceramic coating has an excess of oxygen vacancies therein" fails to have original descriptive support in the Specification inasmuch as the Examiner has properly determined that the original Specification discloses "only that when yttria is used with zirconia an excess of oxygen vacancies results' (Ans. 4, last para.). As explained by the Examiner, there is no descriptive support for the genus of every possible ceramic with oxygen

vacancies since "ceramics in general include many possible materials, from various oxides, silicides, borides, carbides, etc." (Ans. 5, second para.). We agree with the Examiner that Appellants' one disclosed species does not convey to one of ordinary skill in the art that Appellants have invented species sufficient to constitute the broad genus presently claimed. Indeed, we observe that Appellants have not offered any argument in support of the proposition that the original Specification describes a genus of primary ceramic coatings within the scope of claim 13.

We also agree with the Examiner that the original Specification does provide descriptive support for the claim 13 language "cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating." As set forth by the Examiner, the Specification discloses that only cerium in the +4 for oxidation state is effective for removing oxygen vacancies from zirconia/yttria compositions but discloses nothing about the effectiveness for other oxidation states of cerium, such as the +3 state. Appellants' reply that they are "not aware that the +3 oxidation state of cerium" removes oxygen vacancies falls far short of establishing that the original Specification reasonably conveys to one of ordinary skill in the art that cerium in oxidation states other than the +4 may be used to remove the oxygen vacancies (Br. 8, first para.). Hence, the Examiner's prima facie case stands unrebutted.

We next consider the Examiner's § 103 rejection of claims 13-21 over Subramanian in view of Stoffer. As noted by the Examiner, this rejection is essentially the same rejection the Board sustained in the prior appeal of the present application. In summary, we remain of the opinion that one of ordinary skill in the art would have found it obvious to select cerium in the

oxidation state of +4 (CeO_2) as the stable oxide in the process of Subramanian '945 for providing a heat resistant ceramic oxide sheath material over the columns of the thermal barrier coating on a turbine blade.

Appellants acknowledge that "Subramanian teaches applying a yttria-stabilized zirconium thermal barrier coating to nickel-base super alloys," while "Stoffer teaches applying cerium-based corrosion-protection layers to aluminum alloys" (Br. 10, third para.). Appellants therefore maintain that "[t]here is nothing in Subramanian that suggests that a cerium-based corrosion-protection layer, that is otherwise applied to aluminum alloys, would be applied to a yttria-stabilized thermal barrier coating." (*id.*). However, as set forth by the Examiner and stated in our prior opinion, Subramanian expressly teaches that a cerium oxide may be used as the heat resistant ceramic oxide sheath material, and Stoffer evidences that it was known in the art that cerium oxide (CeO_2) is a highly stable oxide.

We also totally reject Appellants' argument that the cerium oxide disclosed by Subramanian is $(CeO_2)_zO_w$, rather than CeO_2. While the language at column 2, lines 35-40 of Subramanian is not a model of clarity, we, for the reasons set forth in the prior appeal, are convinced that one of ordinary skill in the art, considering Subramanian as a whole, would have readily understood that C in the formula represents cerium, not cerium oxide.

Appellants also contend that neither Subramanian nor Stoffer mentions "cerium in an oxidation state that removes oxygen vacancies from the primary ceramic coating" (Br. 12, penultimate para.). However, the Examiner has properly established a prima facie case of inherency based upon Appellants' own Specification disclosure. Specification paragraph

[0012] states "[w]hen yttria is added to zirconia, it produces an excess of oxygen vacancies," and paragraph [0030] states that "[t]he formation of CeO_2 or other +4 cerium oxide acts to remove the oxygen vacancies to thereby slow the diffusion of oxygen anions through the ceramic . . . [t]he CeO_2 sintering inhibitor thereby slows and preferably prevents this sintering process." Accordingly, we agree with the Examiner that although one of ordinary skill in the art would have been taught by the combined teachings of Subramanian and Stoffer to apply a coating of CeO_2 for a purpose other than removing oxygen vacancies, such a result would necessarily occur.

We now turn to the Examiner's § 103 rejection of claims 1-5, 7, 9, and 13-21 over Villiger in view of Subramanian '082 and Liu. As explained by the Examiner, Villiger discloses a process of inhibiting corrosion of a thermal barrier coating of yttria/zirconia by applying a sealing medium comprising a solution of cerium acetate, a cerium-oxide-precursor compound that meets the requirement of the presently claimed "not cerium oxide with cerium in a +4 oxidation state." As acknowledged by the Examiner, Villiger does not teach that the primary ceramic coating comprising columnar grains with facing surfaces, but we agree with t he Examiner that the Subramanian '082 establishes the obviousness of performing the ceramic coating of Villiger as a plasma-sprayed columnar microstructure (*see* Subramanian '082 at col. 4, ll. 55-65 and Fig. 3). Appellants present the following argument regarding the combination of Villiger and Subramanian '082:

> The problem with the attempt to combine these teachings is that Villiger teaches closing off and sealing pores, while the present claims recite "leaving air-filled gaps between the facing surfaces of the columnar grains." If the pores cannot

> be sealed so that gaps are left between the columnar grains, as hypothesized by the explanation of the rejection for the structure of Subramanian, then a person of ordinary skill has no motivation to even attempt to use Villiger's approach."

(Br. 17).

However, we find that Appellants' argument is totally refuted by the Examiner's rationale set forth at pages 43-46 of the Answer. In essence, the Examiner accurately sets forth that Villiger recognizes that large pores in the ceramic layer will not be sealed off thereby rendering them amendable to the cerium oxide treatment of Subramanian '082 for providing a sintering inhibiting material. We agree with the Examiner that "from the application method described by Villiger, it is clear that at least some sealant will enter the [large] pores and be in the pores, simply not close off the pores" (Ans. 44).

As for the recitation of claims 6 and 11 that the cerium-oxide-precursor compound is ammonium cerium sulphate, the Examiner properly cites Ueda for teaching that ammonium cerium sulphate is a well known cerium compound precursor for conversion to cerium oxide by calcining. Appellants' argument that Ueda is non-analogous is misplaced since the Examiner cites Ueda only as a teaching reference for the fact that such a cerium compound is known to be a precursor for forming cerium oxide. Hence, it is or no moment with respect to the propriety of the rejection that Ueda is directed to abrasive particles rather than thermal barrier coatings.

As a final point, Appellants base no argument upon objective evidence of nonobviousness, such as unexpected results, which

would serve to rebut the inference of obviousness established by the applied prior art.

In conclusion, based on the foregoing and the reasons well stated by the Examiner, the Examiner's decision rejecting the appealed claims is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv)(effective Sept. 13, 2004).

AFFIRMED

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